

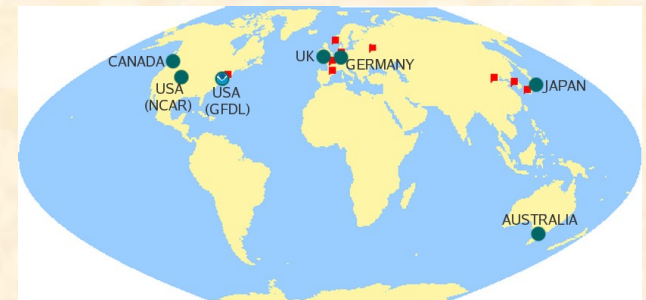
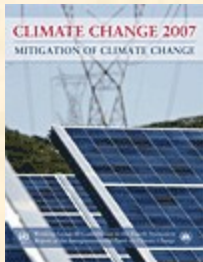
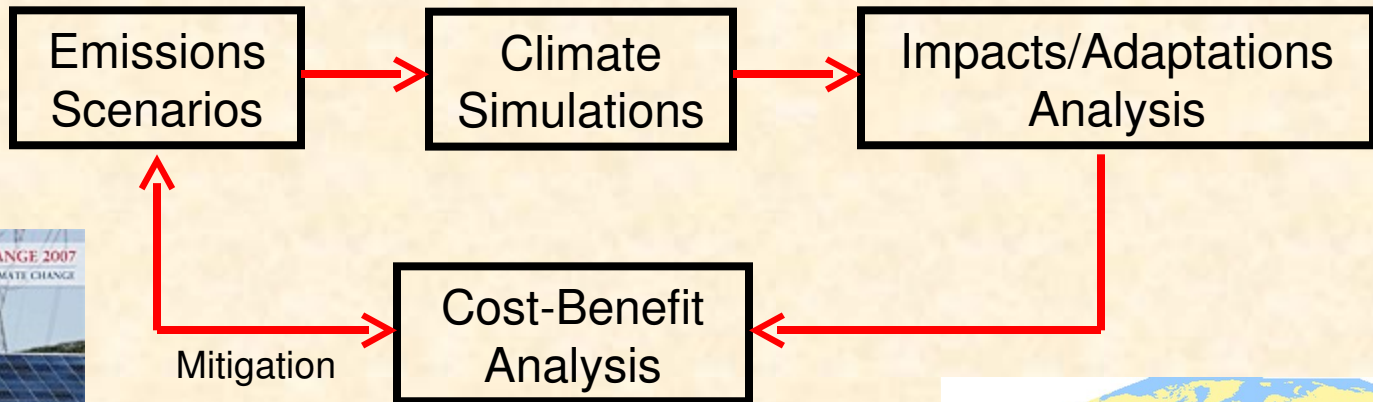
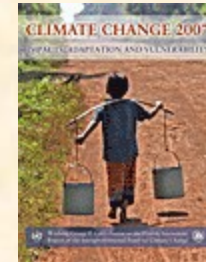
Climate Modeling for Urban Planning



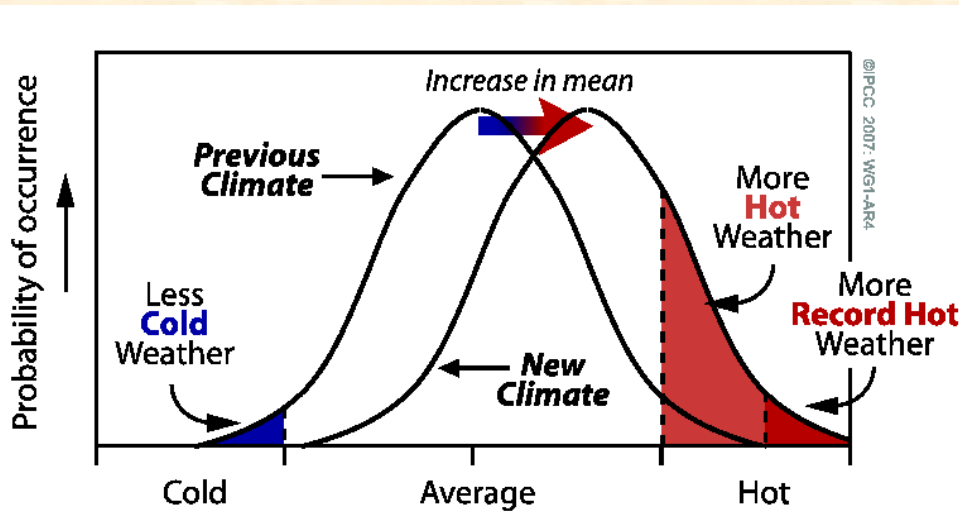
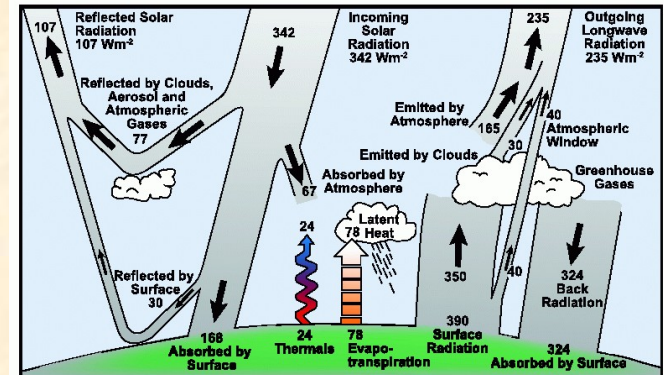
Michael Winton
21 May 2008
NOAA/GFDL



The Climate Change Information Food Chain a la IPCC

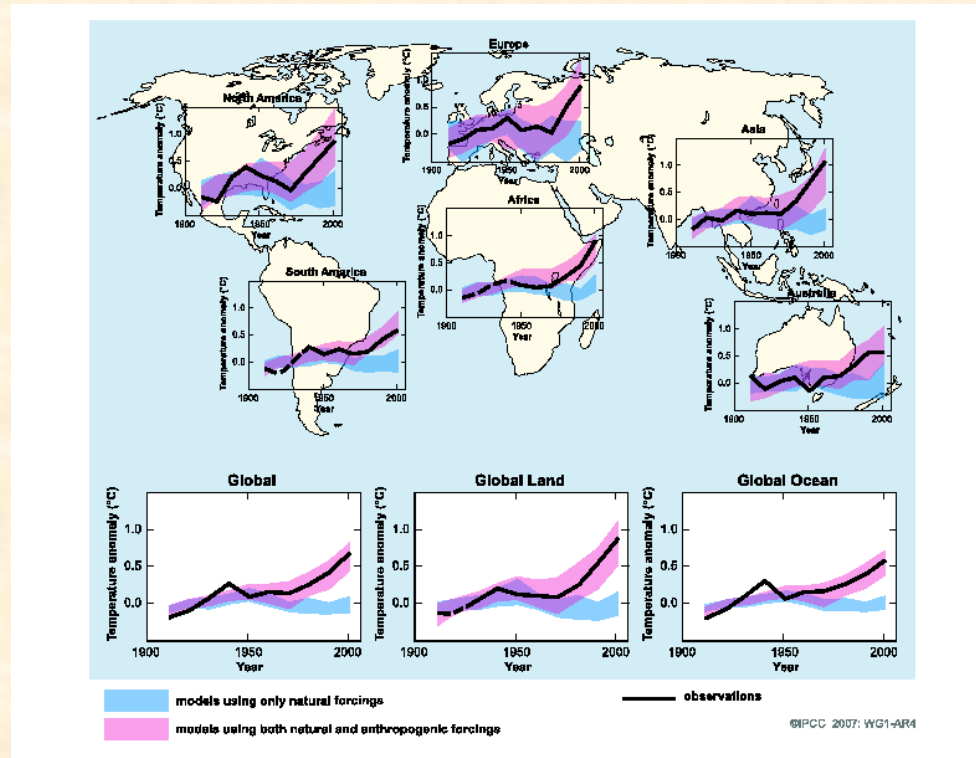


The Earth's energy balance is the key to long-term climate prediction



Climate models predict future weather *probabilities*

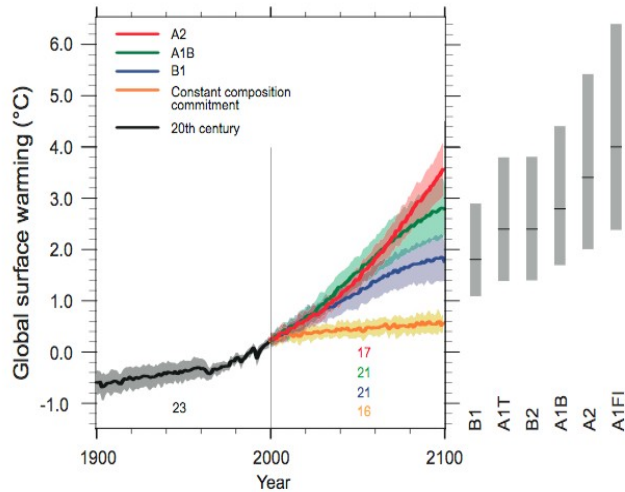
Models agree that there is an anthropogenic component to the current warming



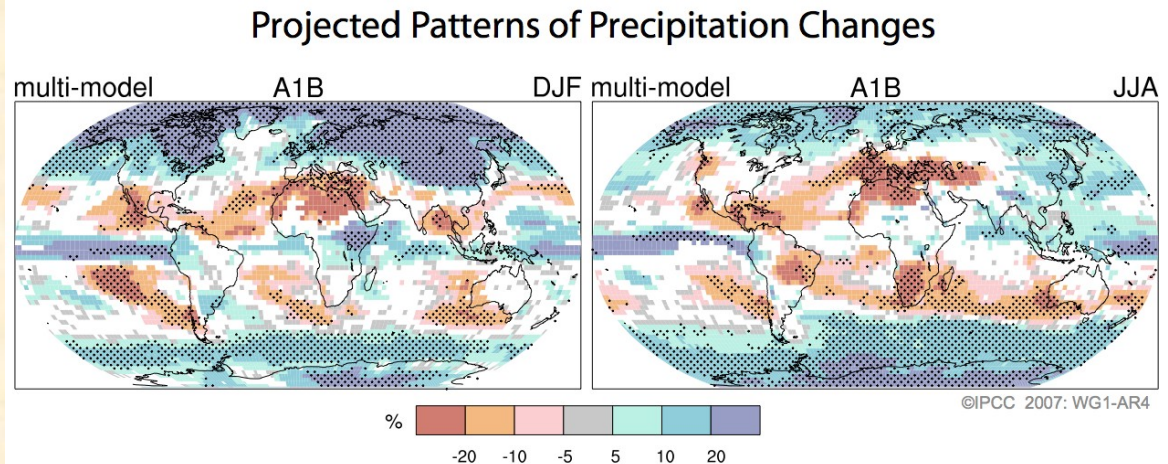
(1) Detection: something beyond natural variability is happening to the global climate

(2) Attribution: anthropogenic forcing is that “something”

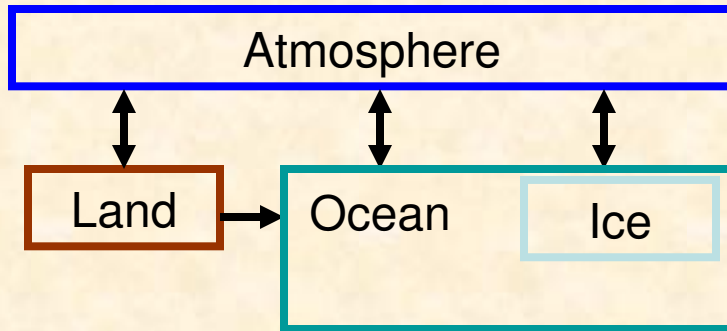
What do GCMs agree/disagree on?



- Global changes
- Large scale patterns



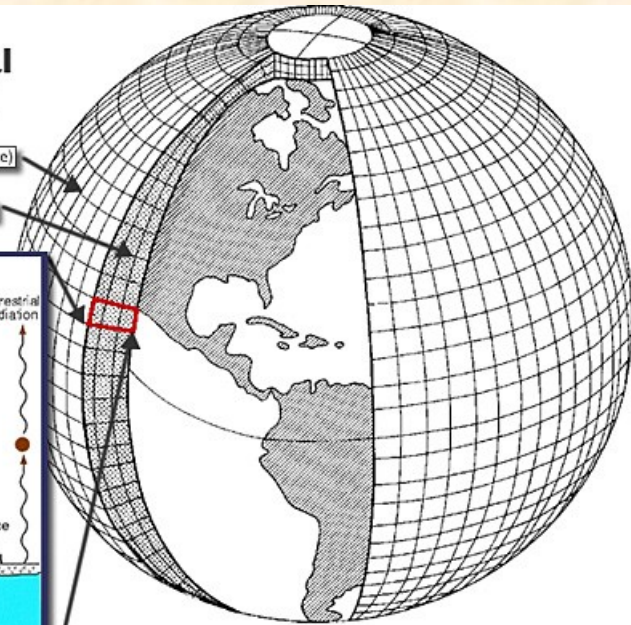
Climate model equations are cast on global grids and solved on a computer



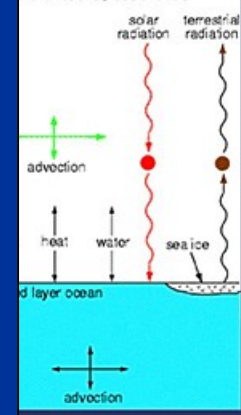
Schematic for Global Atmospheric Model

Horizontal Grid (latitude - longitude)

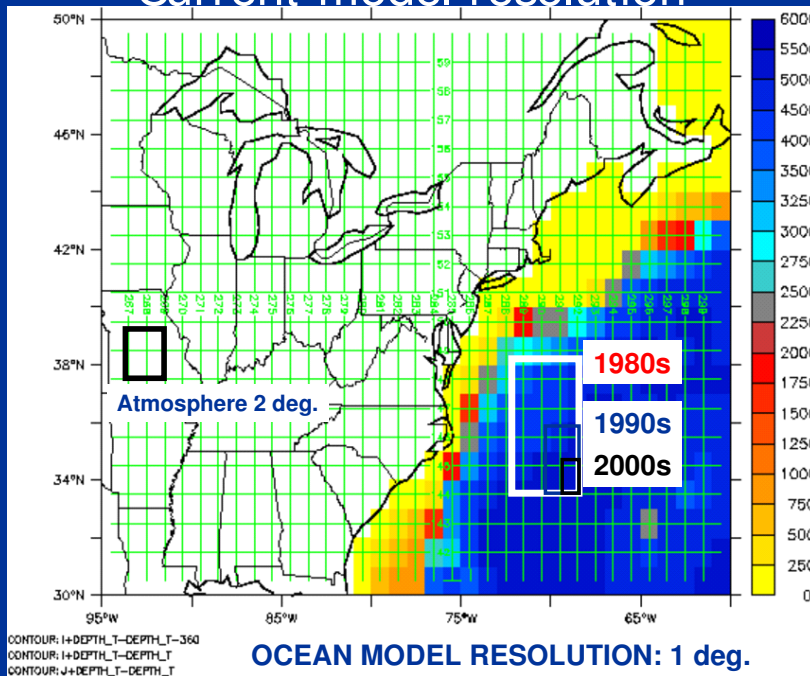
Vertical Grid (height or pressure)



Processes in a Model



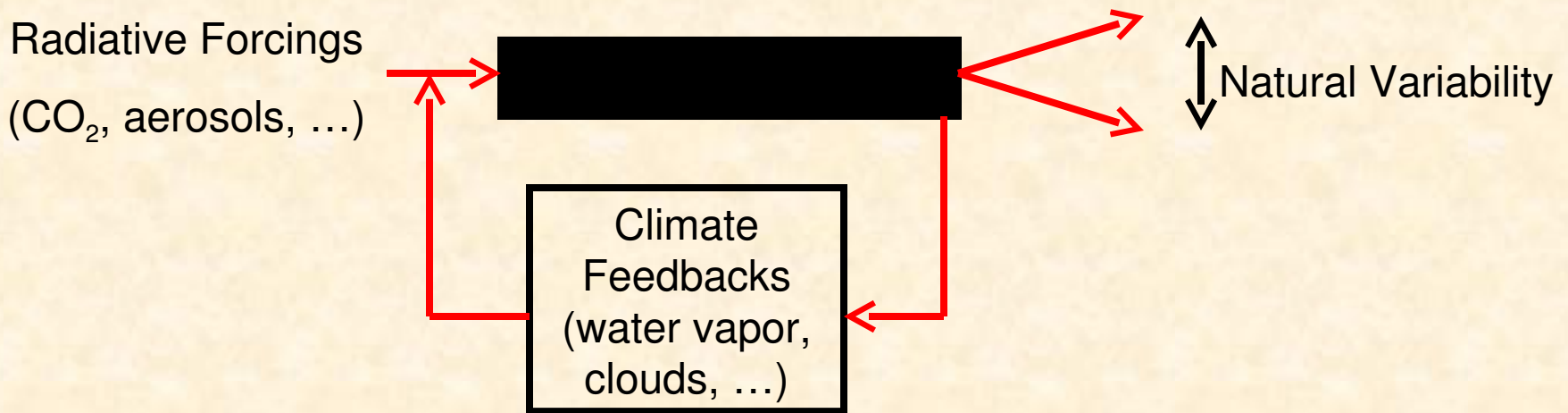
Current model resolution



Simulated vs. Parameterized

- Simulated processes: larger than grid-scale, based on bedrock scientific principles (conservation of energy, mass and momentum). Example: storms.
- Parameterized processes: smaller than grid scale, formulations guided by physical principles but also make use of observational data. Example: clouds.

Why do GCMs disagree?

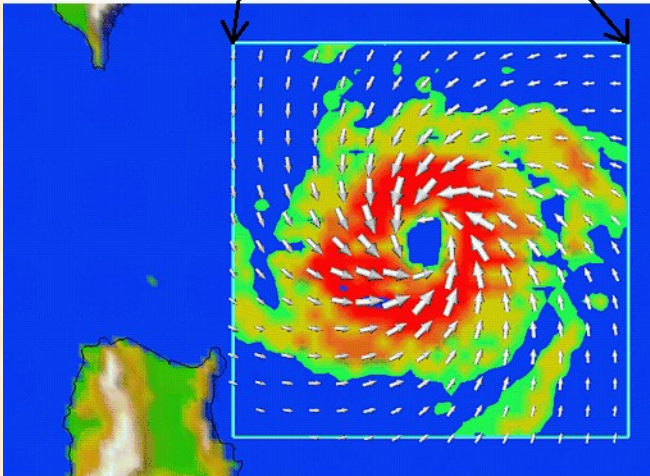
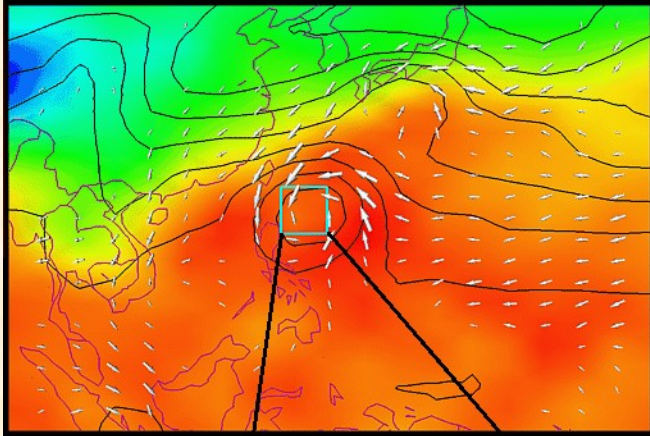


- Forcings are different: e.g. aerosols
- Feedbacks are different: e.g. clouds
- Natural variability: but we can reduce this with ensemble of simulations

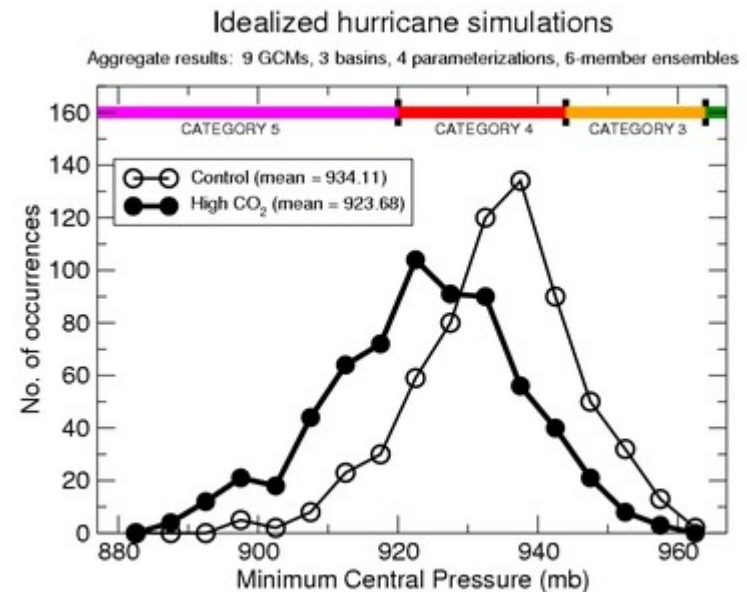
Downscaling can help: e.g. hurricane strength

Environments from 9 GCMs

~ 1/2 category increase in hurricane intensity

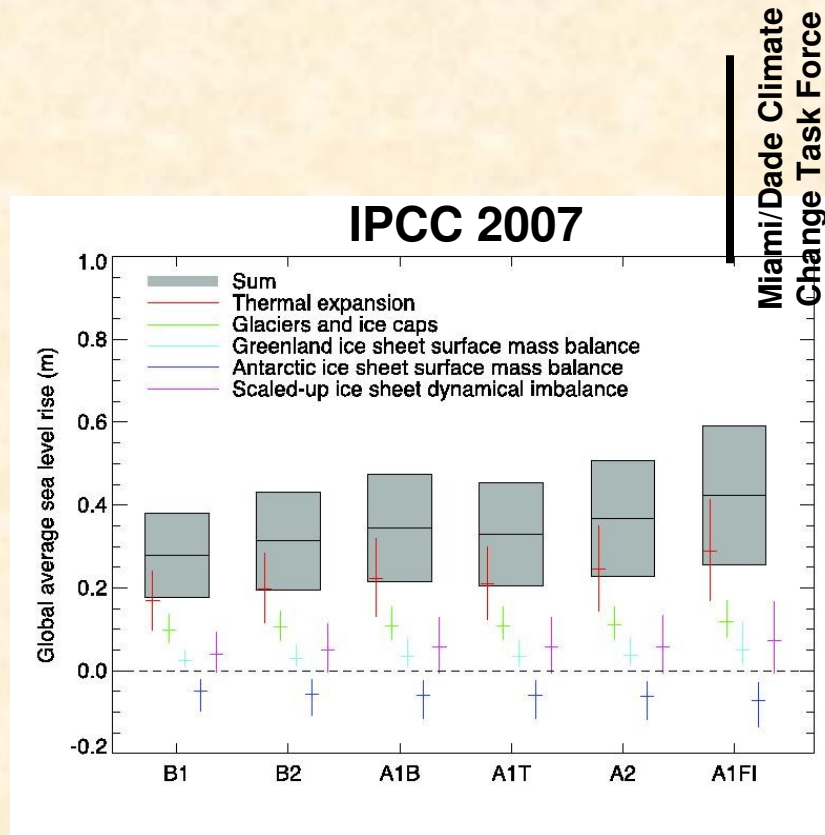


Downscaling with 4 versions
of GFDL hurricane model



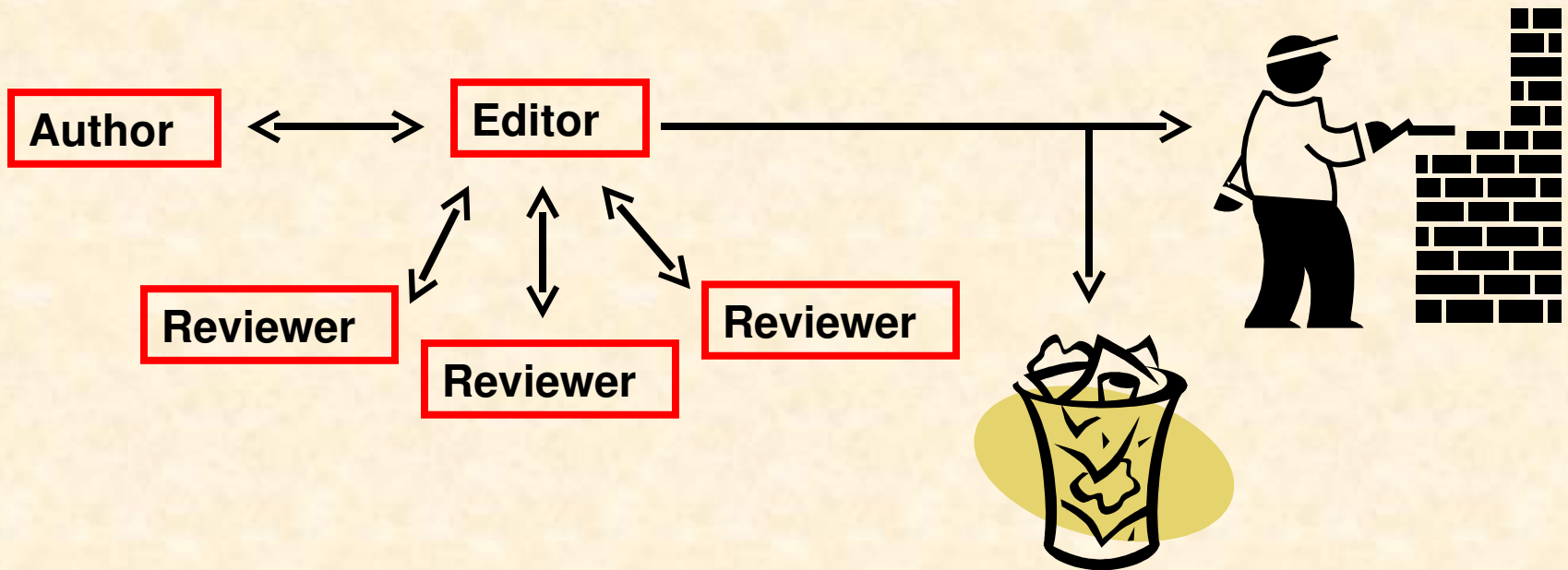
Knutson and Tuleya (2004)

Sea level: Different Uncertainties



- Thermal expansion of oceans
- Melting of glacier & small ice caps
- Melting/Accumulation on ice sheets
- Ice sheet flow changes

Assess the quality of climate information; peer reviewed is best



Conclusions

- Current climate models agree qualitatively but have significant quantitative differences. Improving the accuracy of climate models is a long-term endeavor.
- Downscaling can help (to some extent); the multi-model approach should be employed.
- Read the labels on your climate change info. Assessments such as the IPCC and CCSP are useful gateways to peer-reviewed studies.